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(71)Applicant : XEROX CORP
(72)Inventor : CROWLEY JOSEPH M
RICHLEY EDWARD A
SHERIDON NICHOLAS K

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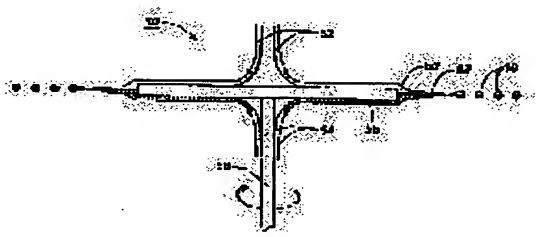
(54) APPARATUS AND METHOD FOR PRODUCING TWO -COLOR BALL

(57)Abstract:
PURPOSE: To provide a simplified method and apparatus high in mass productivity and forming a semispherical two-color ball.
CONSTITUTION: Curable liquid colored white and black are supplied to the upper and under surfaces of the disc 56 attached to a rotatable spindle (shaft) 58 by suitable distributing (dispensing) nozzles 52, 54. The liquids receive the influence of centrifugal force to move along the upper and under surfaces and together flow (without being mixed) so as to form a dichroic storage part 60 having parallel outer surfaces at the edge part of the disc 56 and a ligament 62 extends from the storage part 60 to distribute balls 10 at the terminal part of the storage part 60.



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(71)出願人　590000798
ゼロックス　コーポレイション
XEROX　CORPORATION
アメリカ合衆国　ニューヨーク州　14644
ロチェスター　ゼロックス　スクエア
（番地なし）

(72)発明者　ジョーセフ　エム．クロウリイ
アメリカ合衆国　カリフォルニア州
95037　モーガン　ヒル　ジャクソン　オークス　ドライヴ　16525

(74)代理人　弁理士　中島　淳　（外２名）

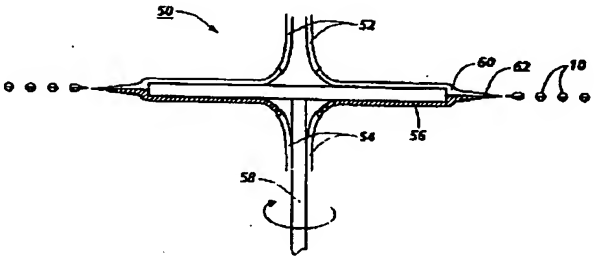
最終頁に続く

(54)【発明の名称】　二色ボールの製造装置及び方法

(57)【要約】

【目的】　大量生産性の高い、半球形状の二色ボールを形成するための簡略化された方法及び装置を提供する。

【構成】　白色及び黒色に着色された硬化可能液は、好適な分配（ディスペンシング）ノズル５２と５４によって、回転可能なスピンドル（軸）５８に取り付けられているディスク５６の上表面と下表面に導入される。液体は遠心力の影響を受けて上下のそれぞれの面の表面を移動する。液体は、ディスク５６のエッジで外面の並行する二色性貯蔵部６０を形成するように一緒に流れ（しかし、混じらない）、貯蔵部６０からリガメント６２が延出し、末端部でボール１０を分配する。



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【特許請求の範囲】

【請求項１】　二色ボールを製造するための装置であって、

第一表面と、前記第一表面の反対に配置された第二表面と、前記第一及び第二の両面と接触するエッジ部分とを含むセパレータ部材と、

第一及び第二の異なる色に着色された硬化可能液体物質が実質的に同一流速で前記エッジ部分に到着するように、前記第一及び第二の液体物質を前記第一及び第二表面上を前記エッジ部分に向かって流す手段であって、前記液体物質の貯蔵部を前記エッジ部分のアウトボードに形成し、前記貯蔵部は前記第一及び第二の液体物質の並行部分からなる流動手段と、

異なる色の並行部分を有する複数の二色ストリームとして流体媒体へ前記貯蔵部から第一及び第二の液体物質を進めるための手段であって、各ストリームの前端部が不安定になり、複数の液滴に分離し、前記液滴は複数の球形のボールを形成し、前記ボールの各々は、異なる色に着色された硬化可能液の半球からなる、第一及び第二の液体物質を進めるための手段と、

更に、前記二色ボールを収集するための手段と、

を備える、二色ボールの製造装置。

【請求項２】二色ボールを製造するための方法であって、

第一及び第二の異なる色に着色された硬化可能液体物質が実質的に同一流速でエッジ部分に到着するように、前記第一及び第二の液体物質をセパレータ部材の両面上を前記セパレータ部材のエッジ部分に向かって流動させるステップと、

前記第一及び第二の液体物質の貯蔵部を、前記端部分のアウトボードに形成するためのステップであって、前記貯蔵部は前記第一及び第二の液体物質の並行する部分からなる、ステップと、

前記第一及び第二の液体物質を前記貯蔵部から、異なる色の並行する部分を有する複数の二色ストリームの流体媒体へ進めるためのステップと、

各ストリームの前端部が不安定になり、複数の液滴に分離し、前記液滴は複数の球形のボールを形成し、前記ボールの各々は、異なる色に着色された硬化可能液からなるステップと、

更に、前記二色ボールを収集するためのステップと、

を備える、二色ボールの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、「電子ペーパ」ディスプレイシートに使用される対比色の半球体を有する、直径約５ミクロンから２００ミクロンの小さなボールの大量製造に関する。

【０００２】

【従来の技術】ディスプレイシートは、紙の書類（ペーパドキュメント）の属性を多数有する薄い透明なシートを含む。このディスプレイシートは紙に似ており、紙のように周辺光調整弁作用を有し（即ち、周囲光が明るくなるにつれて、このディスプレイシートは一層見え易くなる）、紙のように可撓性があり、紙のように持ち運ぶことができ、紙のように書き込むことができ、紙のようにコピーすることができ、紙のアーカイバルメモリ（保存記憶）をほぼ有する。このディスプレイ材料の顕著な特徴は、各々が直径５ミクロンから２００ミクロンの半球形が互いに異なる色の二色のボールでぎっしり充填された、数ミルの厚さのエラストマーのホスト層である。各二色ボールは、半分が白色で、半分が黒色等の対比色の半球体を有すると共に、誘電液で満たされた自己用の球形の空洞中に含まれる。このホスト層の両面上に配置された電極の間に電界を印加すると直ちに、電界の極性に応じて観察者に一方又は他方の半球体を呈するように回転する。

【０００３】図１（ａ）に示されているように、二色ボール１０はホストマトリックス１４の空洞１２に満たされた液体中に配置されている。これらのボールを取り囲む液体１６と当該ボール自体は、どちらも誘電性である。したがって、当該ボールは巨視的には電気的に中性であるが、微視的尺度では（図示されるように）相反する符号（極性）の電荷（帯電）の二層からなる電気二重層を有する。一方の電荷層はボールの表面に集中し、他方の電荷層は、ボールの表面から誘電液中に外方へ延出する空間電荷に似ている。電気二重層の測定可能なアスペクトはゼータ電位として知られている。ゼータ電位は、印加された場の下で、誘電液を介するボールの動きに付随するせん断面の範囲内に存在する、正味の表面と容積電荷により決定される。所定の液体の場合、ゼータ電位はボール表面物質のみの関数である。したがって、各半球体１８と２０の色はたは反射率に付随する差を生じさせる物質の性質によって、空洞１２中の誘電液１６に対して異なる特性のゼータ電位を発生させる。図１（ｂ）に示されるように、電界の存在下でボールを双極子のように作動させるのは、ボールの半球体間のゼータ電位の差である。ボール１０は、その双極子ベクトルが互いに反対の電極２２と２４の間に設定される電界の方向と一致するまで回転する。

【０００４】

【発明が解決しようとする課題】本発明の目的は、大量生産性の高い、半球形状の二色ボールを形成するための簡略化された方法を提供することである。

【０００５】

【課題を解決するための手段と作用】本発明は、半球形状の二色ボールの製造装置を提供することによって１つの形態で実行することができる。その装置とは、第一表面と第一表面の反対側に配置された第二表面と前記両表面に接触するエッジ領域とを有するセパレータ（分離）

部材と、第一色及び第二色に着色された硬化可能液体物質が実質的に同じ流速でエッジ部分に到着し、前記エッジ部分のアウトボード（外側）に貯蔵部を形成するように第一及び第二表面上に前記液体物質をそれぞれ、流す手段とからなる。前記貯蔵部は互いに混じらない異なる色の並行部分からなる。更に、第一及び第二液体物質を複数の並行する二色ストリームとして貯蔵部から流体媒体中へ進めるための手段であって、二色ストリームは前端部が不安定になり、球形ボールを形成する液滴を分離し、球形ボールの各々は、異なる色の硬化可能液体からなる前記手段及び、二色ボールを収集するための手段が提供される。

【０００６】本発明の態様は、二色ボールを製造するための装置であって、第一表面と、前記第一表面の反対に配置された第二表面と、前記第一及び第二の両面と接触するエッジ部分とを含むセパレータ部材と、第一及び第二の異なる色に着色された硬化可能液体物質が実質的に同一流速で前記エッジ部分に到着するように、前記第一及び第二の液体物質を前記第一及び第二表面上を前記エッジ部分に向かって流す手段であって、前記液体物質の貯蔵部を前記エッジ部分のアウトボードに形成し、前記貯蔵部は前記第一及び第二の液体物質の並行部分からなる流動手段と、異なる色の並行部分を有する複数の二色ストリームとして流体媒体へ前記貯蔵部から第一及び第二の液体物質を進めるための手段であって、各ストリームの前端部が不安定になり、複数の液滴に分離し、前記液滴は複数の球形のボールを形成し、前記ボールの各々は、異なる色に着色された硬化可能液の半球からなる、第一及び第二の液体物質を進めるための手段と、更に、前記二色ボールを収集するための手段と、を備える。

【０００７】更に、本発明の態様は、二色ボールを製造するための方法であって、第一及び第二の異なる色に着色された硬化可能液体物質が実質的に同一流速でエッジ部分に到着するように、前記第一及び第二の液体物質をセパレータ部材の両面上を前記セパレータ部材のエッジ部分に向かって流動させるステップと、前記第一及び第二の液体物質の貯蔵部を、前記端部分のアウトボードに形成するためのステップであって、前記貯蔵部は前記第一及び第二の液体物質の並行する部分からなる、ステップと、前記第一及び第二の液体物質を前記貯蔵部から、異なる色の並行する部分を有する複数の二色ストリームの流体媒体へ進めるためのステップと、各ストリームの前端部が不安定になり、複数の液滴に分離し、前記液滴は複数の球形のボールを形成し、前記ボールの各々は、異なる色に着色された硬化可能液からなるステップと、更に、前記二色ボールを収集するためのステップと、を備える。

【０００８】

【実施例】図３（ａ）、（ｂ）では、二つの異なる色の半球体１８と２０を有する、小さな、着色された（又は染色された）ボール１０を作る汎用型の製造装置が図示されている。硬化可能液物質から成る２つの微細な平面ストリーム２６と２８は、延長ノズル３０と３２通って送給されるが、これらのノズルの先端は２つの微細なストリームをセパレータ部材３８の両平面３４と３６へ向けている。液体はその両平面の端部へ流れて、エッジ４０を越え、そこで液体物質のアウトボード貯蔵部を形成する。各ストリームが流れるべき表面距離に対して各ストリームの分配速度を制御することによって、各ストリームがエッジに到着する流速を同じにすることが可能であり、これにより、貯蔵部４２は各液体を同量含むことができる。液体が混ざらないことは留意されるべきであり、そのために貯蔵部は貯蔵部の並行部分４４と４６を含む。セパレータのエッジ４０からホスト流体（空気は示されていない）への液体の流速が十分大きい場合、自由噴流（ジェット）４８が形成される。各噴流は、噴流の発生端部で貯蔵部によって送り出される液体のリガメント（帯）から構成され、リガメントの末端部で並行する二色ボール１０へ分離する。これらのボールは飛びつづけるにつれて硬化し、重力の影響を受けて落下して、最終的に収集される。

【０００９】実験的に、溶融カルナウバワックス（carnauba wax）と溶融ポリエチレンが使用されたが、これらの物質は共に、十分に加熱されると溶けて自由に流れると共に、固体へ凍結する。下記の配合に従って白色と黒色のボールを形成するためにカルナウバワックスを着色した。白色のワックスには、カルナウバワックス１０部、TiO_2 ５部、ワックス内に分散されるように顔料の性能を向上させる界面活性剤であるAerosol OT-100（ニュージャージー州、ウェイン所在のアメリカンサイアナミッド社(American Cyanamid Co.)の登録商標）０．１部を使用した。黒色のワックスには、１０部のカルナウバワックス、黒色無機顔料であるFerroV-302（オハイオ州、クレーブランド所在のフェロ社(Ferro Corporation)の登録商標）１．５部、Aerosol OT-100 ０．１部を使用した。

【００１０】図４に示されている、製造装置のスピニングディスク構造５０は、所望のサイズの半球形の二色ボールを造るための最良の形態（ベストモード）であることが分かった。白色及び黒色に着色された硬化可能液は、好適な分配（ディスペンシング）ノズル５２と５４によって、回転可能なスピンドル（軸）５８に取り付けられているディスク５６の上表面と下表面に導入される。液体は遠心力の影響を受けて上下のそれぞれの面の表面を移動する。液体は、ディスク５６のエッジで外面の並行する二色貯蔵部６０を形成するように一緒に流れ（しかし、混じらない）、貯蔵部６０からリガメント６２が延出し、末端部でボール１０（図５、図６に記す）を分配する。毎分約２６００から３０００回転する約２０ミルの厚さで直径３インチのディスクは、直径約４ミ

ルのボールを連続的に生成することがわかった。回転速度が速すぎると、それぞれの液体は矩形のエッジで一緒に流れずにディスクの表面から流れ出て、そして比較的小さな黒色と白色の単色のボールになる。もちろん、比較的高速度で液体が一緒に流動可能であるように矩形のエッジの好適な変更、例えば縁を丸くする又は、先細にする等の変更は、知られている。

【００１１】スピニングディスク５６のエッジをこえて流れる液体は、不均一な直径のリングの形状をしたアウトボード貯蔵部６０を形成する傾向がある。このリングはディスクと同速度で移動し、表面張力に対して作用する遠心力により生じる”テーラー不安定性（Taylor instabilities）”として公知の周辺突出部を有する。ボール形成機構は引き続き図６に示される。先ず、液体が貯蔵部を形成すると、突出部がａで形成される。更に物質が貯蔵部に送られると、各突出部はｂでピークになり始め、リガメント即ち、液体チューブの送りによって突出部に取りつけられている液体の大きな液滴をｃで放つ。最終的に、ｄで大きな液滴は破壊されて、小さな液滴になる。次に、比較的安定した安定の状況があり、ｅで液体が貯蔵部やリガメントへ送り込まれ、実質的に均一の液滴がリガメントの末端部からホスト流体へ射出される。ディスクを追跡するスピニングリガメントの慣性構造は（図５に明確に示されているように）表面張力によって一緒に保たれており、リガメントの末端部を不安定にすると共に、複数の液滴に分離させる。ディスクの円周が一定である必要はない。実際に、周囲を歯状の構造とすることは、”テーラー不安定性（Taylor instabilities）”の原因となり、その結果として生じるリガメントは各歯と一致して位置される。これにより、リガメント構造の変更と、ボールの寸法の追加制御が行える。

【００１２】満足な働きをすることがわかった液体供給構造体は、更に、詳細について図７に示されている。液体供給構造体は、間でディスク５６を支持する下部液体計量部材６８と上部液体計量部材７０を含む回転可能な分配アセンブリ６６から成る。下部液体計量部材は、適切なモーター（図示されていない）で取り付け可能で回転可能なスピンドル部分７２と、液体を受け取るための中心穴７６を有する結合延出部７４と、上方向に放射状に延出してる多数の液体供給ポート７８と、環状の貯蔵部８０及び、ディスクの下側表面へ液体の薄い層を分配する環状の計量リップ８２を含んでいる。上部液体計量部材７０は、結合延出部７４を囲んでおり、ロック（止め）ナット８４で所定の位置に固定されている。上部液体計量部材７０は、内部の溝８６を含んでおり、この溝は、下方向に放射状に延出してる多数の液体供給ポート８８と通じ、更に、この液体供給ポートは環状の貯蔵部９０及び、ディスクの上側表面へ液体の薄い層を放出するための環状の計量リップ９２に通じている。

【００１３】固定配液アセンブリ９４はディスク５６の上下表面のそれぞれに白色及び黒色の液体を放出するために、回転可能な分配アエンブリ６６に着座されている。配液アセンブリ９４は、対象となる配液ホース９８及び１００を連結できる外部結合部材９６と、ディスクの対象となる面に液体を向ける内部のルート割当（経路付け）部材１０２を含む。結合部材９６は、内部に中心穴１０４を有しており、その中心穴は、止めねじ１０６により所定の位置に固定されたルート割当部材１０２の上半分を収容する。配液アセンブリが適切に着座されると、ルート割当部材１０２の外面上を軸状に延出するチャンネル１０８は、外部結合部材９６を通過して、一方の配液ホース９８と通じるポート１１０と位置合わせされる。軸状に延出するチャンネル１０８の下端部はルート割当部材の外面にある環状の溝１１２で終端となる。ルート割当部材を通る中心穴１１４は他方の配液ホース１００に連通する結合部材９６の中心穴１０４と一直線になっている（位置合わせされている）。

【００１４】回転可能な分配アセンブリ６６と固定配液アセンブリは９４は、下部液体計量部材６８の結合延出部７４を結合部材９６中の中心穴１０４へ挿入することにより連結される。この連結により、ルート割当部材１０２の下半分は、下部液体計量部材６８の中心穴７６に導入される。連結されると、環状の溝１１２は結合延出部７４を通過する多数の軸状のポート１１３と位置合わせされ、内部の溝８６と連通する。この配液アセンブリ全周にわたる溝に配置されるＯリング１１６は、回転可能な分配アセンブリと固定配液アセンブリの間に適切な密閉状態を提供し、矢印ＡとＢで示されているそれぞれの流動パス（経路）から二つの液体が漏れないようにする。

【００１５】上述のように、黒色と白色に着色された液体は、加熱、溶融状態（着色されたカルナウバワックスの場合は約１２０℃、ポリエチレンの場合は約２４０℃）でこれらの計量部材に配液されるので、液体は自由に流動し、早まって硬化しない。即ち、リガメントの凍結を防ぐ十分な時間がある。加熱コイル１１８又は他の加熱デバイスは、固定配液アセンブリ９４と接触するように配置される。液体ワックスによりヴィトン（Viton: E.L. duPont de Nemours の登録商標）等のフッ化炭化水素ゴムで作られたＯリングは、所望される温度に耐えるので適切であると共に、実際に、液体によって滑らかにされることが分かった。１０プシー（psi）の圧力水頭は、それぞれのパスを介して液体を送るのに十分であり、貯蔵部を満たし、ディスクの両面全体に、約２ミルから４ミルの厚さで、計量スロットを介して液体を均一に送るので、液体は混じることなく同量にアウトボード貯蔵部を満たし、リガメントを形成し、最終的に半球形二色ボールを形成することがわかった。

【００１６】幾つかの実験で直面した問題は、ボールの早すぎる、即ちボールが十分に硬化する前の衝突であっ

た。この問題は、図８に示されているアウトボード電極構造体の設備により減少又は取り除かれた。スピニングディスクセパレータ部材５６のアウトボード（外側）で等距離に取り付けられている一対の固定ディスク電極１２０及び１２２は、電気的に接地されたディスクに対してソース（電源）１２４によって印加された約１２０００ボルトＤＣ電圧（スパークを開始する電圧の直ぐ下で）を有する。電界は電極の負の電位とスピニングディスクの正（接地）の電位の間に作られる。液体が僅かでも導電性であれば、正電荷はリガメントとボール中で誘起され、ボールは電極の方へ向いて加速される。電極１２０と１２２の間でバランスのとれた電界は、ボールをその電極の間に飛ばせる。誘起した電荷がボールを互いに反発させるので、衝突は減少する。上述の実施例において、硬化されたボールは、電極１２０と１２２上に蓄積する傾向がある。ボールが電極１２０と１２２の上に蓄積することが望ましくない場合は、図９に示されるように、電極の設計の変更可能である。同軸上の電極対１２６、１２８、及び１３０は、概略的に示されているように、各対の電位が次の隣の対から減少されている電位を有する。ボールは次に、一番外側にある電極対１３０を超えて集積する。この配置はボールをより急速に低速化するために用いることもできる。

【００１７】直面した他の問題は、一つのピグメントの他のピグメントへの螺旋状の移動による完全に半球形状の二色ボールの歩止まりが著しく減少されたことであった。この問題は、スピニングディスクが発する横風によって生じるが、この横風は液滴がリガメントを離れるとその液滴をゆがめる。図１０の実施例ではこの問題を減少し、結果として歩止まりを著しく増やすことが分かった。頂部の保護ディスク１３２と底部の保護ディスク１３４はディスク５６の両面からわずかに離間されて、ディスクの半径方向外方に延出するように回転可能な分配アセンブリに取り付けられており、そしてこの分配アセンブリと一緒に動く。これにより保護ディスク間の空気はスピニングディスクと一緒に移動し、リガメントとボールと共に移動する相対的に鎮静状態の空気を提供する。これらの素子（部材）の実験的な寸法の例は、２０ミルの厚さで、直径３インチのディスクは、９０ミル離間された直径５インチの保護ディスクを有する。即ち、各保護ディスクは、スピニングディスクの上下の各面から約３５ミル離間される。

【００１８】液体物質は早い時期に固体化されるべきでないことが述べられたが、一方、ボールの形成後にはボールは直ちに固体化されるべきであることも分かっている。冷却は、図１１に示されているように、ボールを冷却領域１３６を通過させることによって、促進されてもよい。これは、ボールの形成後すぐに、ボールが低温度の液体窒素の蒸気１４２を通過するように、スピニングディスクの下に液体窒素１４０を含むトレー１３８を配置することにより実験的に行わた。これにより、この位置での硬化が確実になされる。

【００１９】本発明の他の実施例は図１２に示されており、二つの硬化可能液体物質はホース１４４及び１４６を通って送られ、車軸シャフト１５２の回りを回転する外輪（パドルホイール）アセンブリ１５０の各ブレード１４８（二つしか示されていない）の両面に導入されるようになっている。１５４や１５６等の適切な計量オリフィスは、各ブレードの根元の両側に、車軸シャフトを介して設置されている。上述の方法と同様の方法で、好適なスピニングディスクの実施例に関する二つの液体は遠心力によりブレードの両面上へ移動する。二つの液体は混じり合わないが共にエッジを越えて流れ、リガメントが延出し、ボールが排出されるアウトボード貯蔵部を形成する。

【図面の簡単な説明】

【図１】（ａ）は電界の印加前の、空洞に満たされた誘電液内の各ボール半球体に付随された（係わる）電気二重層の概略図であり、（ｂ）は電界の印加によってボールを回転させた後の、空洞に満たされた誘電液内の各ボール半球体に付随された電気二重層の概略図である。

【図２】空洞内の二色ボールの回転及び移動の概略図である。

【図３】（ａ）はセパレータ部材の頂部及び底部を流れており、そのセパレータ部材の並行する二色自由噴流アウトボードを形成する、硬化可能液の異なる２色のストリームの概略斜視図であり、（ｂ）は図３のボール形成部分を示す拡大概略正面図である。

【図４】二色ボールを形成するスピニングディスク分離器の概略正面図である。

【図５】ボールが自由噴流又はリガメントから発するのを示すスピニングディスクの部分拡大概略平面図である。

【図６】ボールが自由噴流又はリガメントから発する起源を示す拡大概略平面図である。

【図７】セパレータ表面上に硬化可能液物質を流すための液体送り構造の拡大断面図である。

【図８】アウトボード電極を有するスピニングディスクボール形成装置の概略図である。

【図９】アウトボード電極の変更実施例を有するスピニングディスクボール形成装置の概略図である。

【図１０】ボールが射出される空気の乱流を減少するために、所定の位置に頂部と底部の保護を有するスピニングディスクボール形成装置の概略図である。

【図１１】ボールの固化を促進するために冷却領域を設けるように変更されたスピニングディスクボール形成装置の概略図である。

【図１２】スピニングの外輪分離機の概略斜視図である。

【符号の説明】

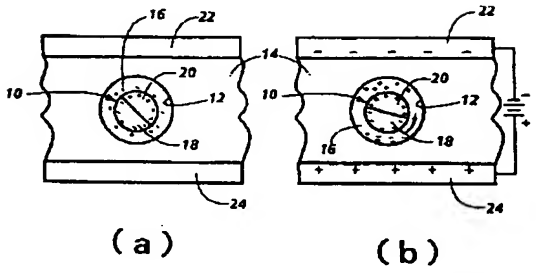
9

１０　二色ボール
５０　スピニングディスク構造
５２　分配ノズル
５４　分配ノズル

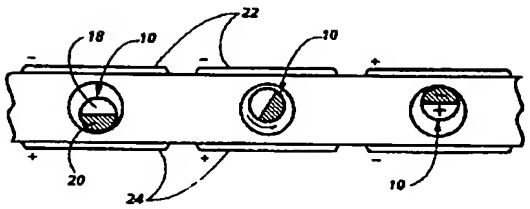
10

５６　ディスク
６０　貯蔵部
６２　リガメント

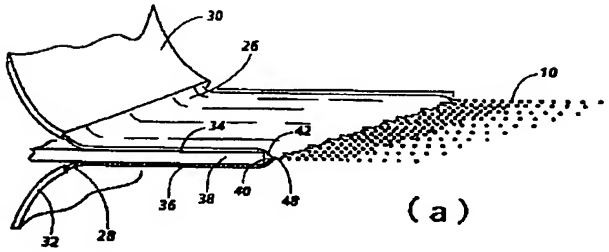
【図１】



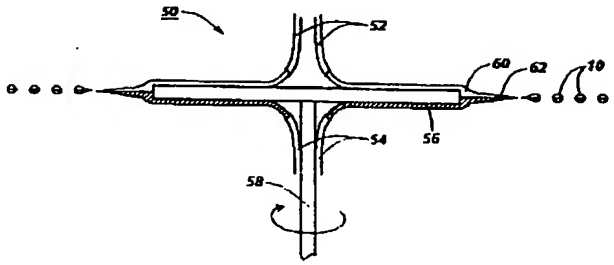
【図２】



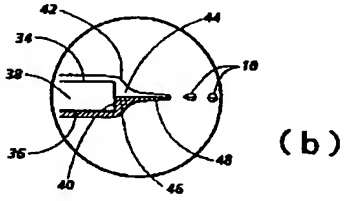
【図３】



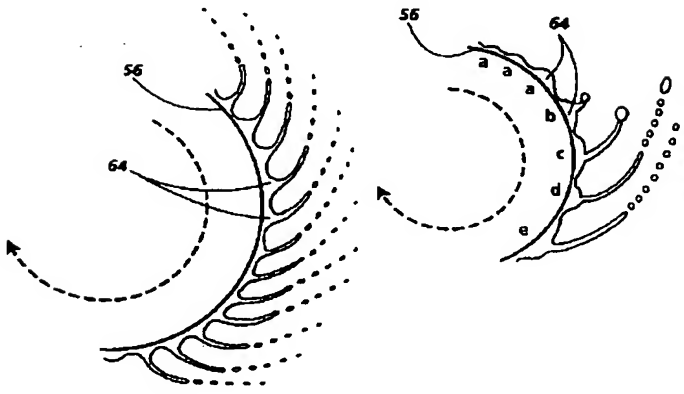
【図４】



【図５】



【図６】



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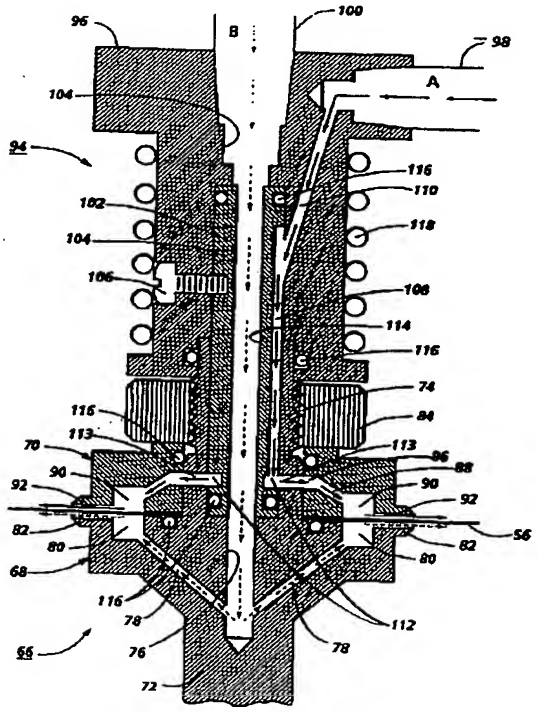

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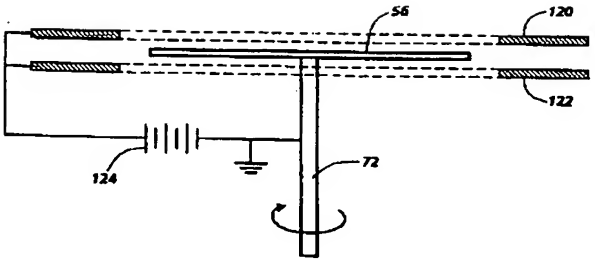
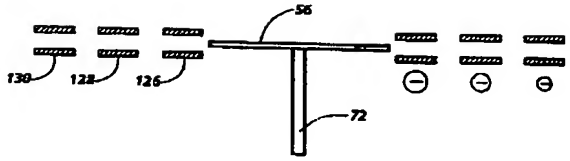
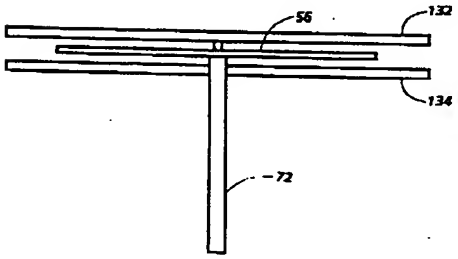


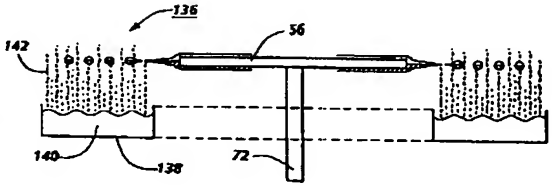
【図９】



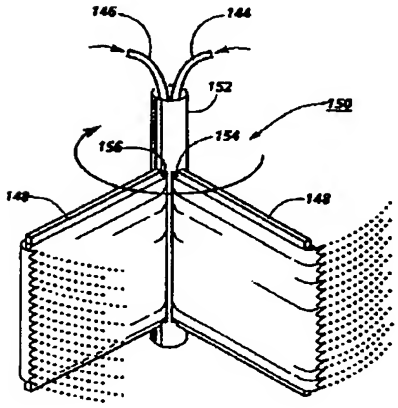
【図１０】



【図１１】



【図１２】



フロントページの続き

(72)発明者　エドワード　エイ．リッチリイ
アメリカ合衆国　カリフォルニア州
94306　パロ　アルト　シルヴァ　コート
4392

(72)発明者　ニコラス　ケイ．シェリドン
アメリカ合衆国　カリフォルニア州
94022　ロス　アルトス　ガーランド　ウ
エイ　101

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The second front face which is equipment for manufacturing a two-color ball, and has been arranged reversely [of the first front face and said first front face], So that the fluid material which was colored the color in which the first and the second differ from the separator member containing the edge part in contact with said first and second both sides and which can be hardened may reach said edge part by the same rate of flow substantially It is a means to pour said first and second fluid material for the said first and second front-face top toward said edge part. A flow means by which form the stores dept. of said fluid material in the out board of said edge part, and said stores dept. consists of concurrency parts of said first and the second fluid material, It is a means for carrying forward the first and the second fluid material to a fluid medium from said stores dept. as two or more two-color streams which have the concurrency part of a different color. The front end section of each stream becomes unstable, and separates into two or more drops, and said drop forms two or more globular form balls. Each of said ball The manufacturing installation of a two-color ball equipped with the means for carrying forward the first and the second fluid material which consist of a semi-sphere of the liquid which was colored a different color, and which can be hardened, and the means for collecting said two-color balls further.
[Claim 2] So that the fluid material which is an approach for manufacturing a two-color ball, and was colored the color from which the first and the second differ and which can be hardened may reach an edge part by the same rate of flow substantially The step which makes both-sides top of a separator member said first and second fluid material flow toward the edge part of said separator member, The step which said stores dept. becomes from the part with which it is a step for forming the stores dept. of said first and the second fluid material in the out board of said edge part, and said first and the second fluid material are concurrent, The step for advancing to the fluid medium of two or more two-color streams which have the part with which a different color is concurrent from said stores dept. in said first and second fluid material, The front end section of each stream becomes unstable, and separates into two or more drops, and said drop forms two or more globular form balls. Each of said ball The manufacture approach of a two-color ball equipped with the step which consists of liquid which was colored a different color, and which can be hardened, and the step for collecting said two-color balls further.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to extensive manufacture of a 200-micron small ball from the diameter of about 5 microns which has the hemisphere of the contrast color used for an "electronic paper" display sheet.
[0002]
[Description of the Prior Art] A display sheet contains the thin transparent sheet which has many attributes of the document (paper document) of paper. This display sheet resembles paper, has an ambient light regulator-valve operation like paper (that is, this display sheet much more becomes easy to appear as an ambient light becomes bright), it has flexibility like paper, can be carried like paper, can be written in like paper, can be copied like paper, and has the archival memory (archival memory) of paper mostly. The remarkable description of this display ingredient is the host layer of an elastomer with a thickness of several mils into which each was tightly filled up with the ball of the two color of a color with which 200-micron semi-spheres differ mutually from the diameter of 5 microns. A two color each ball is contained all over the cavity of the globular form for the selves filled with dielectric liquid while one half is white and one half has the hemisphere of contrast colors, such as black. Shortly after impressing electric field between the electrodes arranged on both sides of this host layer, it rotates so that the hemisphere of one side or another side may be presented to an observer according to the polarity of electric field.
[0003] The two-color ball 10 is arranged in the liquid filled in the cavity 12 of the host matrix 14 as shown in drawing 1 (a). Both of liquid 16 which enclose these balls, and ball itself [concerned] are dielectrics. Therefore, macroscopically, although the ball concerned is neutrality electrically, it has the electric double layer which consists of a bilayer of the charge (electrification) of an opposite (it is illustrated like) sign (polarity) with a microscopic scale. Concentrating one charge layer on the surface of a ball, the charge layer of another side resembles the space charge which extends from the front face of a ball to the method of outside in dielectric liquid. The aspect with a measurable electric double layer is known as F-potential. F-potential is determined by the net front face and net volume charge which exist within the limits of the shear side which accompanies a motion of the ball through dielectric liquid under the impressed place. In the case of a predetermined liquid, F-potential is the function of only ball surface material. Therefore, as for the color of each hemispheres 18 and 20, ** generates the F-potential of the property which changes to the dielectric liquid 16 in a cavity 12 with properties of the matter to produce the difference which accompanies a reflection factor. As shown in drawing 1 (b), it is the difference of the F-potential between the hemispheres of a ball to operate a ball like a dipole under existence of electric field. A ball 10 rotates until it is in agreement with the direction of electric field where the dipole vector is mutually set up among the opposite electrodes 22 and 24.
[0004]
[Problem(s) to be Solved by the Invention] The purpose of this invention is offering an approach having been simplified for forming the two-color ball of a semi-sphere configuration with high high-volume production capability.

[0005]
[Means for Solving the Problem and its Function] This invention can be performed with one gestalt by offering the manufacturing installation of the two-color ball of a semi-sphere configuration. The separator (separation) member which has the edge field which contacts the equipment on the first front face, the second front face arranged in the opposite side of the first front face, and said both front faces, The fluid material which was colored the first color and the second color and which can be hardened reaches an edge part by the same rate of flow substantially, and consists of a means to pour said fluid material on the first and the second front face, respectively so that a stores dept. may be formed in the out board (outside) of said edge part. Said stores dept. consists of a concurrency part of a different color which is not mixed mutually. Furthermore, it is a means for carrying forward the first and the second fluid material into a fluid medium from a stores dept. as a two-color stream with which plurality is concurrent, and the front end section becomes unstable, a two-color stream separates the drop which forms a spherical ball, and a means for each of a spherical ball to collect said means which consists of a liquid of a different color which can be hardened, and two-color balls is offered.
[0006] The mode of this invention is equipment for manufacturing a two-color ball. The first front face, The separator member containing the edge part in contact with the second front face arranged reversely [of said first front face], and said first and second both sides, So that the fluid material which was colored the color from which the first and the second differ and which can be hardened may reach said edge part by the same rate of flow substantially It is a means to pour said first and second fluid material for the said first and second front-face top toward said edge part. A flow means by which form the stores dept. of said fluid material in the out board of said edge part, and said stores dept. consists of concurrency parts of said first and the second fluid material, It is a means for carrying forward the first and the second fluid material to a fluid medium from said stores dept. as two or more two-color streams which have the concurrency part of a different color. The front end section of each stream becomes unstable, and separates into two or more drops, and said drop forms two or more globular form balls. Each of said ball It has a means for carrying forward the first and the second fluid material which consist of a semi-sphere of the liquid which was colored a different color, and which can be hardened, and a means for collecting said two-color balls further.
[0007] Furthermore, so that the fluid material which the mode of this invention is an approach for manufacturing a two-color ball, and was colored the color from which the first and the second differ and which can be hardened may reach an edge part by the same rate of flow substantially The step which makes both-sides top of a separator member said first and second fluid material flow toward the edge part of said separator member, The step which said stores dept. becomes from the part with which it is a step for forming the stores dept. of said first and the second fluid material in the out board of said edge part, and said first and the second fluid material are concurrent, The step for advancing to the fluid medium of two or more two-color streams which have the part with which a different color is concurrent from said stores dept. in said first and second fluid material, The front end section of each stream becomes unstable, and separates into two or more drops, said drop forms two or more globular form balls, and each of said ball is equipped with the step which consists of liquid which was colored a different color, and which can be hardened, and the step for collecting said two-color balls further.
[0008]
[Example] In drawing 3 (a) and (b), the small manufacturing installation of the general-purpose mold which makes the colored ball (or dyed) 10 which has the hemispheres 18 and 20 of two different colors is illustrated. Although two detailed flat-surface streams 26 and 28 which consist of the quality of liquid which can be hardened are fed as an extension nozzle 30 and 32 copies, the tip of these nozzles has turned two detailed streams to both the flat surfaces 34 and 36 of the separator member 38. A liquid flows to the edge of both the flat surface, exceeds an edge 40, and forms the out board stores dept. of fluid material there. making the same the rate of flow to which each stream reaches an edge by controlling the distribution rate of each stream to the surface distance in which each stream should flow -- possible -- thereby -- a stores dept. 42 -- each liquid -- tales-doses **** -- things are made. It should be taken notice of that a liquid is

not mixed, therefore a stores dept. contains the concurrency parts 44 and 46 of a stores dept. When the rate of flow of the liquid from the edge 40 of a separator to a host fluid (air is not shown) is sufficiently large, a free jet (jet) 48 is formed. Each jet consists of ligaments (band) of the liquid sent out by the stores dept. at the generating edge of a jet, and is divided into the two-color ball 10 which is concurrent in the end of a ligament. These balls are hardened as they continue flying, they fall in response to the effect of gravity, and, finally are collected.

[0009] Experimentally, it is melting carnauba wax (carnauba wax). Although melting polyethylene was used, it is frozen to a solid-state while it will melt if both these matter is fully heated, and it flows freely. Carnauba wax was colored in order to form white and a black ball according to the following combination. The carnauba wax 10 section, the TiO2 5 section, and the Aerosol OT-100 (trademark of New Jersey and American Cyanamid (American Cyanamid Co.) of the Wayne whereabouts) 0.1 section that is the surface active agent which raises the engine performance of a pigment so that it may distribute in a wax were used for the white wax. The FerroV-302 1.5 (trademark of Ohio and the ferro company (Ferro Corporation) of the clay brand whereabouts) section and the 1000.Aerosol OT-1 section which are the carnauba wax of the ten sections and a black inorganic pigment were used for the black wax.

[0010] It turned out that it is the best gestalt (best mode) for the spinning disk structure 50 of a manufacturing installation shown in drawing 4 to build the semi-sphere two-color ball of desired size. White and the liquid which was colored black and which can be hardened are introduced into the upper front face and following table side of the disk 56 attached in the pivotable spindle (shaft) 58 by the suitable distribution (dispensing) nozzles 52 and 54. A liquid moves in response to the effect of a centrifugal force in the front face of each up-and-down field. It flows together so that the two-color stores dept. 60 with which external surface is concurrent with the edge of a disk 56 may be formed (however, not mixed), and a ligament 62 extends from a stores dept. 60, and a liquid distributes a ball 10 (it describes in drawing 5 and drawing 6) in an end. It turned out that a disk with a diameter of 3 inches generates a ball with a diameter of about 4 mils continuously by the thickness of about 20 mils rotated 3000 times from about 2600 per minute. If rotational speed is too quick, each liquid will flow out of the front face of a disk, without flowing together with a rectangular edge, and will become the ball of the monochrome of comparatively small black and white. Of course, or it is comparatively high-speed, and it makes round a suitable change of a rectangular edge, for example, an edge, so that a liquid can flow together, modification of making it a taper is known.

[0011] The liquid which surpasses the edge of the spinning disk 56 and flows tends to form the out board stores dept. 60 which carried out the configuration of the ring of an uneven diameter. This ring moves at a disk and this rate, and it has a circumference lobe well-known as "Taylor instability (Taylor instabilities)" produced according to the centrifugal force which acts to surface tension. A ball molding machine style is succeedingly shown in drawing 6 . First, a liquid's formation of a stores dept. forms a lobe by a. Furthermore, if the matter is sent to a stores dept., each lobe will begin to become a peak by b, and will release a ligament, i.e., the big drop of the liquid attached in the lobe by delivery of a liquid tube, by c. Finally, it is destroyed and the big drop at d turns into a small drop. Next, there is a situation of the stability stabilized comparatively, a liquid is sent into a stores dept. or a ligament by e, and the drop of homogeneity is substantially injected from the end of a ligament to a host fluid. While the inertia structure of the spinning ligament which pursues a disk is kept together by surface tension (it is clearly shown in drawing 5 like) and makes the end of a ligament unstable, it is made to divide into two or more drops. The periphery of a disk does not need to be fixed. Making a perimeter into gear-tooth-like structure actually causes "the Taylor instability (Taylor instabilities)", and the ligament produced as the result is located in accordance with each gear tooth. Thereby, additional control of modification of ligament structure and the dimension of a ball can be performed.

[0012] The liquid supply structure carrying out satisfactory work turned out to be is further shown in drawing 7 for details. The liquid supply structure consists of the pivotable distribution assembly 66 containing the lower liquid metering zone material 68 and the up liquid metering zone material 70 which support a disk 56 in between. Lower liquid metering zone material

contains the annular measuring lip 82 which distributes the film of a liquid to the spindle part 72 that it can attach by the suitable motor (not shown), and pivotable, the joint extension section 74 which has the main hole 76 for receiving a liquid, the liquid supply port 78 of a large number which have extended above at the radial, and the annular stores dept. 80 and the bottom front face of a disk. The up liquid metering zone material 70 has surrounded the joint extension section 74, and is being fixed to the position with the lock (stop) nut 84. The up liquid metering zone material 70 includes the slot 86 on internal, and this slot leads to the annular measuring lip 92 for this liquid supply port to emit the film of a liquid to the annular stores dept. 90 and the top front face of a disk further through the liquid supply port 88 of a large number which have extended to the radial downward.

[0013] The fixed **** assembly 94 has sat down to pivotable distribution AEMBURI 66, in order to emit white and a black liquid to each on the front face of vertical of a disk 56. The **** assembly 94 contains the outer join member 96 which can connect the target **** hose 98 and 100, and the routing (path attachment) member 102 of the interior which turns a liquid to the field set as the object of a disk. The bond part material 96 has the main hole 104 inside, and the main hole holds the upper half of the routing member 102 fixed to the position by the setscrew 106. If a **** assembly sits down appropriately, the channel 108 which extends the external surface top of the routing member 102 in the shape of a shaft will pass the outer join member 96, and alignment will be carried out to the port 110 which leads to one **** hose 98. The lower limit section of the channel 108 which extends in the shape of a shaft serves as termination in the annular slot 112 in the external surface of a routing member. The main hole 114 which passes along a routing member is the main hole 104 and straight line of the bond part material 96 which are open for free passage on the **** hose 100 of another side (alignment is carried out).

[0014] It is connected when, as for 94, the pivotable distribution assembly 66 and a fixed **** assembly insert the joint extension section 74 of the lower liquid metering zone material 68 in the main hole 104 in the bond part material 96. The lower half of the routing member 102 is introduced into the main hole 76 of the lower liquid metering zone material 68 by this connection. If connected, alignment of the annular slot 112 will be carried out to the port 113 of the shape of a shaft of a large number which pass the joint extension section 74, and it will be open for free passage with the slot 86 on internal. O ring 116 arranged in the slot covering this **** assembly perimeter offers a sealing condition suitable between a pivotable distribution assembly and a fixed **** assembly, and it is made for two liquids not to leak from each flow pass (path) shown by arrow heads A and B.

[0015] As mentioned above, since these metering zone material **** in the state of heating and melting (it is [in the case of the colored carnauba wax] about 240 degrees C in the case of about 120 degrees C and polyethylene), a liquid flows freely and the liquid colored black and white does not harden it rashly. That is, there is sufficient time amount which prevents freezing of a ligament. A heating coil 118 or other heating devices are arranged so that the fixed **** assembly 94 may be contacted. a liquid wax -- VITON (Viton: trademark of E.L.duPont de Nemours) etc. -- since the O ring made from hydrocarbon fluoride rubber bore the temperature for which it asks, while it was suitable, it actually turned out that it smooths with a liquid. It turned out that the pressure head of 10 PUSHI (psi) is enough to send a liquid through each pass, a stores dept. is filled, a liquid fills an out board stores dept. to tales doses, without blending, a ligament is formed, and a semi-sphere two-color ball is finally formed since it is about 2 to 4 mils in thickness and a liquid is sent to whole both sides of a disk through a measuring slot at homogeneity.

[0016] The ball was too early, namely, the problem faced in some experiments was the collision before a ball fully hardens. This problem was decreased or removed by the facility of the out board electrode structure shown in drawing 8 . the out board (outside) of the spinning disk separator member 56 -- it is -- etc. -- the fixed-disk electrodes 120 and 122 of a pair attached in distance have the about 12000-volt DC electrical potential difference impressed with the source (power source) 124 to the disk grounded electrically (immediately under the electrical potential difference which starts a spark). Electric field are made between the electronegative potential of an electrode, and the forward (touch-down) potential of a spinning disk. If it is

conductivity even when liquids are few, induction of the positive charge will be carried out to a ligament in a ball, and a ball will be accelerated toward the direction of an electrode. The electric field which maintained balance among electrodes 120 and 122 can fly a ball between the electrode. Since the ball of each other is made to repel [charge / which carried out induction], a collision decreases. In an above-mentioned example, it is tended on an electrode 120 and 122 to accumulate the hardened ball. When it is not desirable to accumulate a ball on electrodes 120 and 122, as shown in drawing 9 , modification of a design of an electrode is possible. the electrode pair on the same axle -- 126, 128, and 130 have the potential to which the potential of each set is decreasing from the pair of the next next door as shown roughly. Next, a ball is most accumulated outside exceeding certain electrode pair 130. This arrangement can also be used in order to low-speed-ize a ball more quickly.

[0017] Other faced problems were things to depend on the spiral migration to other pigments of one pigment and which the step stop of the two-color ball of a semi-sphere configuration decreased remarkably completely. Although this problem is produced by the flank wind which a spinning disk emits, this flank wind will distort that drop, if a drop leaves a ligament. In the example of drawing 10 , it turned out that this problem is decreased and a step stop is remarkably increased as a result. The top protection disk 132 and the protection disk 134 of a pars basilaris ossis occipitalis are slightly estranged from both sides of a disk 56, they are attached in the pivotable distribution assembly so that it may extend to the method of the outside of radial of a disk, and they move together with this distribution assembly. Thereby, the air between protection disks provides with the air of sedation the relative target which moves together with a spinning disk and moves with a ligament and a ball. The example of the experimental dimension of these components (member) is 20 mils in thickness, and a disk with a diameter of 3 inches has a protection disk with a diameter of 5 inches estranged 90 mils. That is, about 35 mils of each protection disk are estranged from each field of the upper and lower sides of a spinning disk.

[0018] Although the thing for which fluid material should be solidified early and which do not come out was described, on the other hand, the ball is also understood that it should solidify immediately after formation of a ball. Cooling may be promoted by passing the cooling field 136 in a ball as shown in drawing 11 . This is line cotton experimentally by arranging immediately, the tray 138 which contains liquid nitrogen 140 under a spinning disk after formation of a ball, so that a ball may pass the steam 142 of the liquid nitrogen of whenever [low-temperature]. Thereby, hardening in this location is made certainly.

[0019] Other examples of this invention are shown in drawing 12 , and two fluid material which can be hardened is sent through hose 144 and 146, and is introduced into both sides of each blade 148 (only two are shown) of the outer-ring-of-spiral-wound-gasket (paddle wheel) assembly 150 turning around the surroundings of the axle shaft 152. The suitable measuring orifice of 154 or 156 grades is installed in the both sides of the root of each blade through the axle shaft. By the above-mentioned approach and the same approach, two liquids about the example of a suitable spinning disk move to up to both sides of a blade according to a centrifugal force. Although not mixed, it flows exceeding both edges, and a ligament extends, and two liquids form the out board stores dept. by which a ball is discharged.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention relates to extensive manufacture of a 200-micron small ball from the diameter of about 5 microns which has the hemisphere of the contrast color used for an "electronic paper" display sheet.

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PRIOR ART

[Description of the Prior Art] A display sheet contains the thin transparent sheet which has many attributes of the document (paper document) of paper. This display sheet resembles paper, has an ambient light regulator-valve operation like paper (that is, this display sheet much more becomes easy to appear as an ambient light becomes bright), it has flexibility like paper, can be carried like paper, can be written in like paper, can be copied like paper, and has the archival memory (archival memory) of paper mostly. The remarkable description of this display ingredient is the host layer of an elastomer with a thickness of several mils into which each was tightly filled up with the ball of the two color of a color with which 200-micron semi-spheres differ mutually from the diameter of 5 microns. A two color each ball is contained all over the cavity of the globular form for the selves filled with dielectric liquid while one half is white and one half has the hemisphere of contrast colors, such as black. Shortly after impressing electric field between the electrodes arranged on both sides of this host layer, it rotates so that the hemisphere of one side or another side may be presented to an observer according to the polarity of electric field.
[0003] The two-color ball 10 is arranged in the liquid filled in the cavity 12 of the host matrix 14 as shown in drawing 1 (a). Both of liquid 16 which enclose these balls, and ball itself [concerned] are dielectrics. Therefore, macroscopically, although the ball concerned is neutrality electrically, it has the electric double layer which consists of a bilayer of the charge (electrification) of an opposite (it is illustrated like) sign (polarity) with a microscopic scale. Concentrating one charge layer on the surface of a ball, the charge layer of another side resembles the space charge which extends from the front face of a ball to the method of outside in dielectric liquid. The aspect with a measurable electric double layer is known as F-potential. F-potential is determined by the net front face and net volume charge which exist within the limits of the shear side which accompanies a motion of the ball through dielectric liquid under the impressed place. In the case of a predetermined liquid, F-potential is the function of only ball surface material. Therefore, as for the color of each hemispheres 18 and 20, ** generates the F-potential of the property which changes to the dielectric liquid 16 in a cavity 12 with properties of the matter to produce the difference which accompanies a reflection factor. As shown in drawing 1 (b), it is the difference of the F-potential between the hemispheres of a ball to operate a ball like a dipole under existence of electric field. A ball 10 rotates until it is in agreement with the direction of electric field where the dipole vector is mutually set up among the opposite electrodes 22 and 24.

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TECHNICAL PROBLEM

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OPERATION

[Means for Solving the Problem and its Function] This invention can be performed with one gestalt by offering the manufacturing installation of the two-color ball of a semi-sphere configuration. The separator (separation) member which has the edge field which contacts the equipment on the first front face, the second front face arranged in the opposite side of the first front face, and said both front faces, The fluid material which was colored the first color and the second color and which can be hardened reaches an edge part by the same rate of flow substantially, and consists of a means to pour said fluid material on the first and the second front face, respectively so that a stores dept. may be formed in the out board (outside) of said edge part. Said stores dept. consists of a concurrency part of a different color which is not mixed mutually. Furthermore, it is a means for carrying forward the first and the second fluid material into a fluid medium from a stores dept. as a two-color stream with which plurality is concurrent, and the front end section becomes unstable, a two-color stream separates the drop which forms a spherical ball, and a means for each of a spherical ball to collect said means which consists of a liquid of a different color which can be hardened, and two-color balls is offered.
[0006] The mode of this invention is equipment for manufacturing a two-color ball. The first front face, The separator member containing the edge part in contact with the second front face arranged reversely [of said first front face], and said first and second both sides, So that the fluid material which was colored the color from which the first and the second differ and which can be hardened may reach said edge part by the same rate of flow substantially It is a means to pour said first and second fluid material for the said first and second front-face top toward said edge part. A flow means by which form the stores dept. of said fluid material in the out board of said edge part, and said stores dept. consists of concurrency parts of said first and the second fluid material, It is a means for carrying forward the first and the second fluid material to a fluid medium from said stores dept. as two or more two-color streams which have the concurrency part of a different color. The front end section of each stream becomes unstable, and separates into two or more drops, and said drop forms two or more globular form balls. Each of said ball It has a means for carrying forward the first and the second fluid material which consist of a semi-sphere of the liquid which was colored a different color, and which can be hardened, and a means for collecting said two-color balls further.
[0007] Furthermore, so that the fluid material which the mode of this invention is an approach for manufacturing a two-color ball, and was colored the color from which the first and the second differ and which can be hardened may reach an edge part by the same rate of flow substantially The step which makes both-sides top of a separator member said first and second fluid material flow toward the edge part of said separator member, The step which said stores dept. becomes from the part with which it is a step for forming the stores dept. of said first and the second fluid material in the out board of said edge part, and said first and the second fluid material are concurrent, The step for advancing to the fluid medium of two or more two-color streams which have the part with which a different color is concurrent from said stores dept. in said first and second fluid material, The front end section of each stream becomes unstable, and separates into two or more drops, said drop forms two or more globular form balls, and each of said ball is equipped with the step which consists of liquid which was colored a different color,

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EXAMPLE

[Example] In drawing 3 (a) and (b), the small manufacturing installation of the general-purpose mold which makes the colored ball (or dyed) 10 which has the hemispheres 18 and 20 of two different colors is illustrated. Although two detailed flat-surface streams 26 and 28 which consist of the quality of liquid which can be hardened are fed as an extension nozzle 30 and 32 copies, the tip of these nozzles has turned two detailed streams to both the flat surfaces 34 and 36 of the separator member 38. A liquid flows to the edge of both the flat surface, exceeds an edge 40, and forms the out board stores dept. of fluid material there. making the same the rate of flow to which each stream reaches an edge by controlling the distribution rate of each stream to the surface distance in which each stream should flow -- possible -- thereby -- a stores dept. 42 -- each liquid -- tales-doses **** -- things are made. It should be taken notice of that a liquid is not mixed, therefore a stores dept. contains the concurrency parts 44 and 46 of a stores dept. When the rate of flow of the liquid from the edge 40 of a separator to a host fluid (air is not shown) is sufficiently large, a free jet (jet) 48 is formed. Each jet consists of ligaments (band) of the liquid sent out by the stores dept. at the generating edge of a jet, and is divided into the two-color ball 10 which is concurrent in the end of a ligament. These balls are hardened as they continue flying, they fall in response to the effect of gravity, and, finally are collected.
[0009] Experimentally, it is melting carnauba wax (carnauba wax). Although melting polyethylene was used, it is frozen to a solid-state while it will melt if both these matter is fully heated, and it flows freely. Carnauba wax was colored in order to form white and a black ball according to the following combination. The carnauba wax 10 section, the TiO2 5 section, and the Aerosol OT-100 (trademark of New Jersey and American Cyanamid (American Cyanamid Co.) of the Wayne whereabouts) 0.1 section that is the surface active agent which raises the engine performance of a pigment so that it may distribute in a wax were used for the white wax. The FerroV-302 1.5 (trademark of Ohio and the ferro company (Ferro Corporation) of the clay brand whereabouts) section and the 1000.Aerosol OT-1 section which are the carnauba wax of the ten sections and a black inorganic pigment were used for the black wax.
[0010] It turned out that it is the best gestalt (best mode) for the spinning disk structure 50 of a manufacturing installation shown in drawing 4 to build the semi-sphere two-color ball of desired size. White and the liquid which was colored black and which can be hardened are introduced into the upper front face and following table side of the disk 56 attached in the pivotable spindle (shaft) 58 by the suitable distribution (dispensing) nozzles 52 and 54. A liquid moves in response to the effect of a centrifugal force in the front face of each up-and-down field. It flows together so that the two-color stores dept. 60 with which external surface is concurrent with the edge of a disk 56 may be formed (however, not mixed), and a ligament 62 extends from a stores dept. 60, and a liquid distributes a ball 10 (it describes in drawing 5 and drawing 6) in an end. It turned out that a disk with a diameter of 3 inches generates a ball with a diameter of about 4 mils continuously by the thickness of about 20 mils rotated 3000 times from about 2600 per minute. If rotational speed is too quick, each liquid will flow out of the front face of a disk, without flowing together with a rectangular edge, and will become the ball of the monochrome of comparatively small black and white. Of course, or it is comparatively high-speed, and it makes round a suitable change of a rectangular edge, for example, an edge, so that a liquid can flow together,

modification of making it a taper is known.
[0011] The liquid which surpasses the edge of the spinning disk 56 and flows tends to form the out board stores dept. 60 which carried out the configuration of the ring of an uneven diameter. This ring moves at a disk and this rate, and it has a circumference lobe well-known as "Taylor instability (Taylor instabilities)" produced according to the centrifugal force which acts to surface tension. A ball molding machine style is succeedingly shown in drawing 6 . First, a liquid's formation of a stores dept. forms a lobe by a. Furthermore, if the matter is sent to a stores dept., each lobe will begin to become a peak by b, and will release a ligament, i.e., the big drop of the liquid attached in the lobe by delivery of a liquid tube, by c. Finally, it is destroyed and the big drop at d turns into a small drop. Next, there is a situation of the stability stabilized comparatively, a liquid is sent into a stores dept. or a ligament by e, and the drop of homogeneity is substantially injected from the end of a ligament to a host fluid. While the inertia structure of the spinning ligament which pursues a disk is kept together by surface tension (it is clearly shown in drawing 5 like) and makes the end of a ligament unstable, it is made to divide into two or more drops. The periphery of a disk does not need to be fixed. Making a perimeter into gear-tooth-like structure actually causes "the Taylor instability (Taylor instabilities)", and the ligament produced as the result is located in accordance with each gear tooth. Thereby, additional control of modification of ligament structure and the dimension of a ball can be performed.
[0012] The liquid supply structure carrying out satisfactory work turned out to be is further shown in drawing 7 for details. The liquid supply structure consists of the pivotable distribution assembly 66 containing the lower liquid metering zone material 68 and the up liquid metering zone material 70 which support a disk 56 in between. Lower liquid metering zone material contains the annular measuring lip 82 which distributes the film of a liquid to the spindle part 72 that it can attach by the suitable motor (not shown), and pivotable, the joint extension section 74 which has the main hole 76 for receiving a liquid, the liquid supply port 78 of a large number which have extended above at the radial, and the annular stores dept. 80 and the bottom front face of a disk. The up liquid metering zone material 70 has surrounded the joint extension section 74, and is being fixed to the position with the lock (stop) nut 84. The up liquid metering zone material 70 includes the slot 86 on internal, and this slot leads to the annular measuring lip 92 for this liquid supply port to emit the film of a liquid to the annular stores dept. 90 and the top front face of a disk further through the liquid supply port 88 of a large number which have extended to the radial downward.
[0013] The fixed **** assembly 94 has sat down to pivotable distribution AEMBURI 66, in order to emit white and a black liquid to each on the front face of vertical of a disk 56. The **** assembly 94 contains the outer join member 96 which can connect the target **** hose 98 and 100, and the routing (path attachment) member 102 of the interior which turns a liquid to the field set as the object of a disk. The bond part material 96 has the main hole 104 inside, and the main hole holds the upper half of the routing member 102 fixed to the position by the setscrew 106. If a **** assembly sits down appropriately, the channel 108 which extends the external surface top of the routing member 102 in the shape of a shaft will pass the outer join member 96, and alignment will be carried out to the port 110 which leads to one **** hose 98. The lower limit section of the channel 108 which extends in the shape of a shaft serves as termination in the annular slot 112 in the external surface of a routing member. The main hole 114 which passes along a routing member is the main hole 104 and straight line of the bond part material 96 which are open for free passage on the **** hose 100 of another side (alignment is carried out).
[0014] It is connected when, as for 94, the pivotable distribution assembly 66 and a fixed **** assembly insert the joint extension section 74 of the lower liquid metering zone material 68 in the main hole 104 in the bond part material 96. The lower half of the routing member 102 is introduced into the main hole 76 of the lower liquid metering zone material 68 by this connection. If connected, alignment of the annular slot 112 will be carried out to the port 113 of the shape of a shaft of a large number which pass the joint extension section 74, and it will be open for free passage with the slot 86 on internal. O ring 116 arranged in the slot covering this **** assembly perimeter offers a sealing condition suitable between a pivotable distribution assembly and a

fixed **** assembly, and it is made for two liquids not to leak from each flow pass (path) shown by arrow heads A and B.
[0015] As mentioned above, since these metering zone material **** in the state of heating and melting (it is [in the case of the colored carnauba wax] about 240 degrees C in the case of about 120 degrees C and polyethylene), a liquid flows freely and the liquid colored black and white does not harden it rashly. That is, there is sufficient time amount which prevents freezing of a ligament. A heating coil 118 or other heating devices are arranged so that the fixed **** assembly 94 may be contacted. a liquid wax -- VITON (Viton: trademark of E.L.duPont de Nemours) etc. -- since the O ring made from hydrocarbon fluoride rubber bore the temperature for which it asks, while it was suitable, it actually turned out that it smooths with a liquid. It turned out that the pressure head of 10 PUSHI (psi) is enough to send a liquid through each pass, a stores dept. is filled, a liquid fills an out board stores dept. to tales doses, without blending, a ligament is formed, and a semi-sphere two-color ball is finally formed since it is about 2 to 4 mils in thickness and a liquid is sent to whole both sides of a disk through a measuring slot at homogeneity.
[0016] The ball was too early, namely, the problem faced in some experiments was the collision before a ball fully hardens. This problem was decreased or removed by the facility of the out board electrode structure shown in drawing 8 . the out board (outside) of the spinning disk separator member 56 -- it is -- etc. -- the fixed-disk electrodes 120 and 122 of a pair attached in distance have the about 12000-volt DC electrical potential difference impressed with the source (power source) 124 to the disk grounded electrically (immediately under the electrical potential difference which starts a spark). Electric field are made between the electronegative potential of an electrode, and the forward (touch-down) potential of a spinning disk. If it is conductivity even when liquids are few, induction of the positive charge will be carried out to a ligament in a ball, and a ball will be accelerated toward the direction of an electrode. The electric field which maintained balance among electrodes 120 and 122 can fly a ball between the electrode. Since the ball of each other is made to repel [charge / which carried out induction], a collision decreases. In an above-mentioned example, it is tended on an electrode 120 and 122 to accumulate the hardened ball. When it is not desirable to accumulate a ball on electrodes 120 and 122, as shown in drawing 9 , modification of a design of an electrode is possible. the electrode pair on the same axle -- 126, 128, and 130 have the potential to which the potential of each set is decreasing from the pair of the next next door as shown roughly. Next, a ball is most accumulated outside exceeding certain electrode pair 130. This arrangement can also be used in order to low-speed-ize a ball more quickly.
[0017] Other faced problems were things to depend on the spiral migration to other pigments of one pigment and which the step stop of the two-color ball of a semi-sphere configuration decreased remarkably completely. Although this problem is produced by the flank wind which a spinning disk emits, this flank wind will distort that drop, if a drop leaves a ligament. In the example of drawing 10 , it turned out that this problem is decreased and a step stop is remarkably increased as a result. The top protection disk 132 and the protection disk 134 of a pars basilaris ossis occipitalis are slightly estranged from both sides of a disk 56, they are attached in the pivotable distribution assembly so that it may extend to the method of the outside of radial of a disk, and they move together with this distribution assembly. Thereby, the air between protection disks provides with the air of sedation the relative target which moves together with a spinning disk and moves with a ligament and a ball. The example of the experimental dimension of these components (member) is 20 mils in thickness, and a disk with a diameter of 3 inches has a protection disk with a diameter of 5 inches estranged 90 mils. That is, about 35 mils of each protection disk are estranged from each field of the upper and lower sides of a spinning disk.
[0018] Although the thing for which fluid material should be solidified early and which do not come out was described, on the other hand, the ball is also understood that it should solidify immediately after formation of a ball. Cooling may be promoted by passing the cooling field 136 in a ball as shown in drawing 11 . This is line cotton experimentally by arranging immediately, the tray 138 which contains liquid nitrogen 140 under a spinning disk after formation of a ball, so that

a ball may pass the steam 142 of the liquid nitrogen of whenever [low-temperature]. Thereby, hardening in this location is made certainly.

[0019] Other examples of this invention are shown in drawing 12 , and two fluid material which can be hardened is sent through hose 144 and 146, and is introduced into both sides of each blade 148 (only two are shown) of the outer-ring-of-spiral-wound-gasket (paddle wheel) assembly 150 turning around the surroundings of the axle shaft 152. The suitable measuring orifice of 154 or 156 grades is installed in the both sides of the root of each blade through the axle shaft. By the above-mentioned approach and the same approach, two liquids about the example of a suitable spinning disk move to up to both sides of a blade according to a centrifugal force. Although not mixed, it flows exceeding both edges, and a ligament extends, and two liquids form the out board stores dept. by which a ball is discharged.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) is the schematic diagram of the electric double layer (involved) incidental to each ball hemisphere in the dielectric liquid filled in the cavity before impression of electric field, and (b) is the schematic diagram of the electric double layer incidental to each ball hemisphere in the dielectric liquid filled in the cavity after rotating a ball by impression of electric field.
[Drawing 2] It is the schematic diagram of rotation of the two-color ball in a cavity, and migration.
[Drawing 3] It is the outline perspective view of the stream of two colors from which the liquid which can be hardened differs which (a) is flowing the crowning and pars basilaris ossis occipitalis of a separator member, and forms the two-color free-jet out board on which the separator member is concurrent, and (b) is the expansion outline front view showing the ball formation part of drawing 3 .
[Drawing 4] It is the outline front view of the spinning disk eliminator which forms a two-color ball.
[Drawing 5] It is the partial expansion outline top view of the spinning disk in which it is shown that a ball emits from a free jet or a ligament.
[Drawing 6] A ball is the expansion outline top view showing the origin emitted from a free jet or a ligament.
[Drawing 7] It is the expanded sectional view of the liquid delivery structure for passing the quality of liquid which can be hardened on a separator front face.
[Drawing 8] It is the schematic diagram of the spinning disk ball formation equipment which has an out board electrode.
[Drawing 9] It is the schematic diagram of the spinning disk ball formation equipment which has the modification example of an out board electrode.
[Drawing 10] In order to decrease the turbulent flow of the air with which a ball is injected, it is the schematic diagram of the spinning disk ball formation equipment which has protection of a crowning and a pars basilaris ossis occipitalis in a position.
[Drawing 11] In order to promote solidification of a ball, it is the schematic diagram of the spinning disk ball formation equipment changed so that a cooling field might be prepared.
[Drawing 12] It is the outline perspective view of the outer-ring-of-spiral-wound-gasket separator of spinning.
[Description of Notations]
10 Two-Color Ball
50 Spinning Disk Structure
52 Distribution Nozzle
54 Distribution Nozzle
56 Disk
60 Stores Dept.
62 Ligament

[Translation done.]

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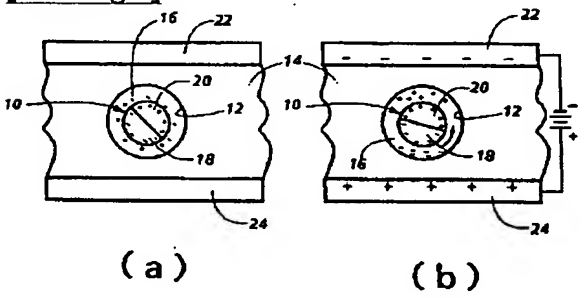
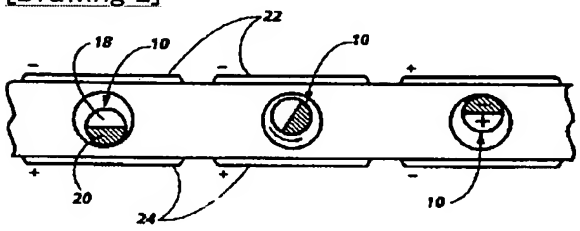
DRAWINGS

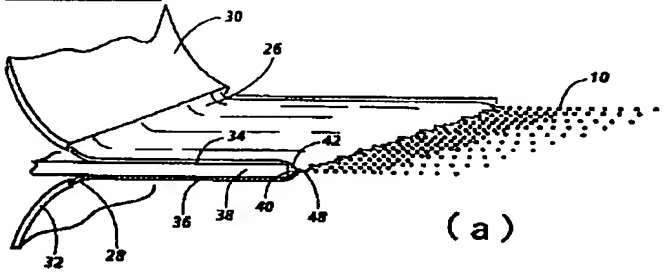
[Drawing 1]

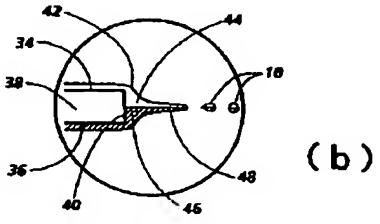


[Drawing 2]

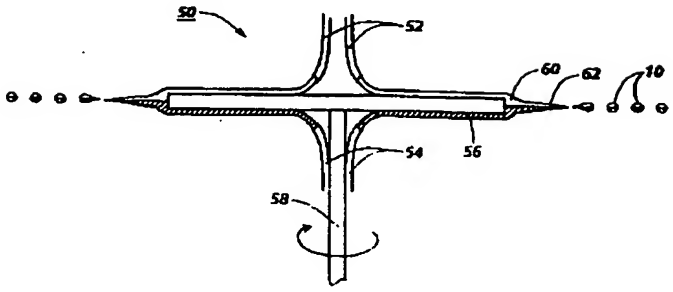


[Drawing 3]

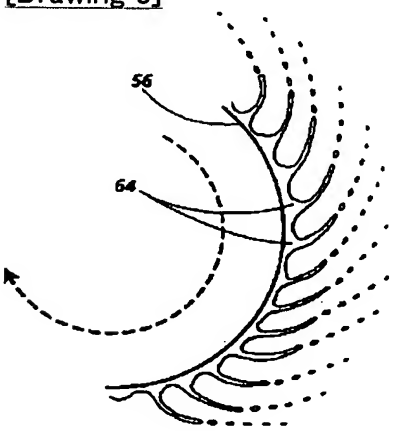




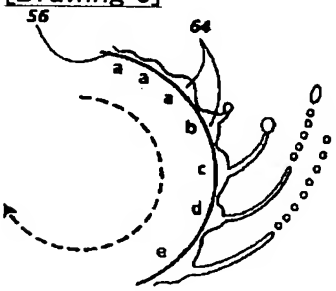
[Drawing 4]



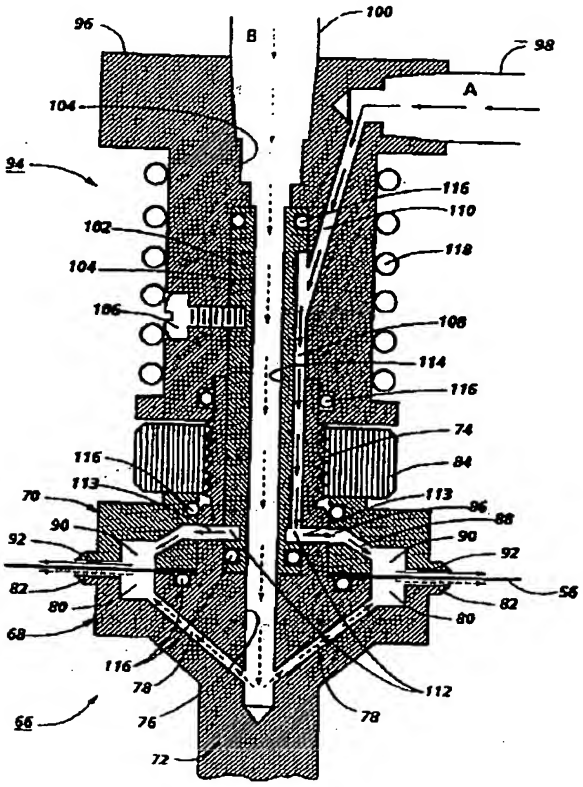
[Drawing 5]



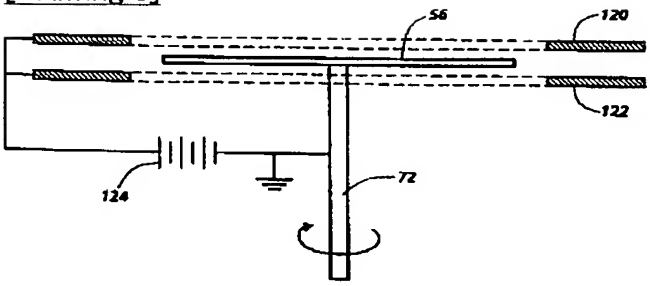
[Drawing 6]



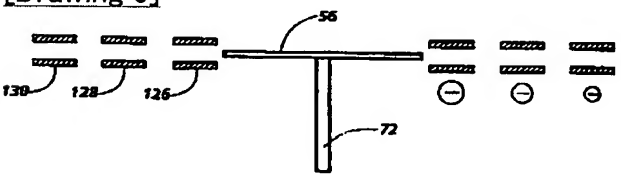
[Drawing 7]



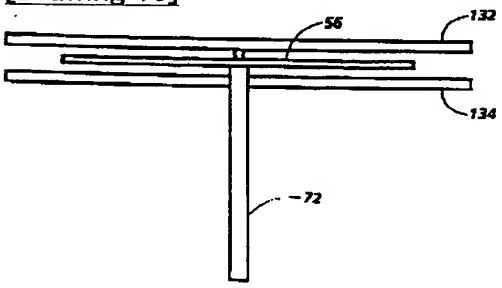
[Drawing 8]



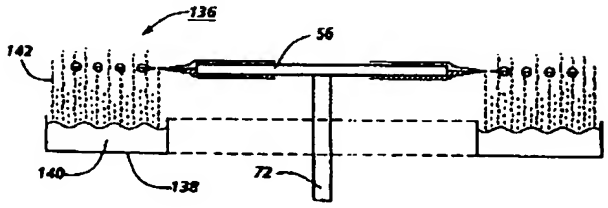
[Drawing 9]



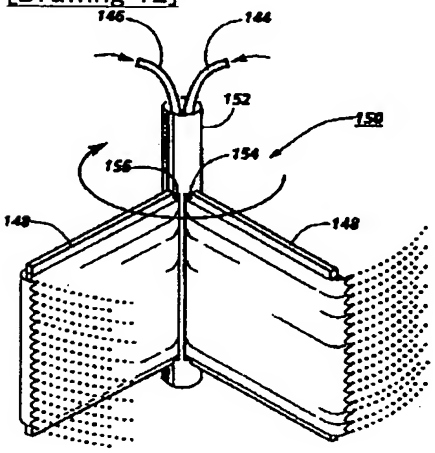
[Drawing 10]



[Drawing 11]



[Drawing 12]



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